LISTING OF CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (Previously Presented) A method executed in a computer system with at least one physical computing device for producing a model of a combined physical system having physical quantities by representing physical quantities of said combined physical system in terms of a combined set of partial differential equations, said method comprising:

representing at least one of a plurality of physical systems as two or more selected application modes modeling physical quantities of said at least one of said plurality of physical systems, wherein said application modes are configured to model the physical quantities for at least one of structural mechanics properties, fluid dynamic properties, electromagnetic properties, chemical reaction properties, acoustic properties, and heat transfer properties of said physical system;

using a first physical computing device, determining a set of partial differential equations for each of said two or more selected application modes, parameters of said partial differential equations being physical quantities of corresponding ones of said plurality of physical systems;

using said first physical computing device or a second physical computing device, forming said combined set of partial differential equations using said determined sets of partial differential equations associated with said one of said plurality of physical systems; and

outputting to a display device or a communication device said model of said combined physical system based on said combined set of partial differential equations for said two or more selected application modes for said one of said plurality of physical systems, whereby said model represents a mathematical expression of said physical quantities of said combined physical system.

2. (Cancelled).

3. (Previously Presented) The method of Claim 1, further comprising:

representing at least one of said physical quantities of a first of said plurality of application modes using at least one dependent variable in said set of partial differential equations corresponding to said first of said plurality of application modes.

4. (Original) The method of Claim 3, further comprising:

representing said at least one of said physical quantities directly as said at least one dependent variable.

5. (Original) The method of Claim 4, further comprising:

representing said at least one of said physical quantities using a relation between said at least one dependent variable and another variable representing said at least one physical quantity.

6. (Original) The method of Claim 5, wherein said at least one of said physical quantities is represented using at least one of: a numerical value and a mathematical expression.

7. (Original) The method of Claim 6, further comprising:

forming said mathematical expression including at least one of: a space coordinate, a time coordinate, a numerical value, and an actual physical quantity.

8. (Original) The method of Claim 1, further comprising:

associating at least one subdomain with each application mode.

9. (Previously Presented) The method of Claim 8, wherein each of said physical quantities is described by at least one physical property, and the method further comprising:

disabling at least one physical quantity and associated variables in a subdomain.

10. (Previously Presented) The method of Claim 1, further comprising:

displaying on said display device a partial differential equation in one of a: coefficient view and a general form corresponding to a representation of said partial differential equation; and

modifying a portion of said partial differential equation.

11. (Original) The method of Claim 10, further comprising:

modifying at least one boundary condition of said partial differential equation.

12. (Original) The method of Claim 10, further comprising:

modifying at least one coefficient of said partial differential equation.

13. (Previously Presented) The method of Claim 10, further comprising:

obtaining data using a graphical user interface in connection with said one of said plurality of physical systems.

14. (Previously Presented) The method of Claim 10, wherein said display device comprises a graphical user interface to display and input data.

15. (Previously Presented) The method of Claim 1, further comprising:

solving said combined system of partial differential equations using a coefficient form of said combined set of partial differential equations.

16. (Previously Presented) The method of Claim 1, further comprising:

solving said combined set of partial differential equations using a general form of said combined system of partial differential equations.

17. (Previously Presented) The method of Claim 16, further comprising:

converting at least one set of partial differential equations included in said combined set of partial differential equations from coefficient to general form.

18. (Previously Presented) The method of Claim 17, further comprising:

converting said combined set of partial differential equations from coefficient to general form.

19. (Previously Presented) The method of Claim 18, further comprising:

using linearization of a general form to solve for a non-linear set of partial differential equations.

20. (Previously Presented) The method of Claim 19, further comprising:

using a Newton method in solving for said non-linear set of partial differential equations.

21. (Previously Presented) The method of Claim 1, further comprising:

solving said combined set of partial differential equations.

22. (Previously Presented) The method of Claim 21, further comprising:

selecting a portion of physical quantities in said combined set of partial differential equations;

solving for one or more variables associated with said portion of physical quantities.

23. (Original) The method of Claim 22, further comprising:

using values associated with physical quantities not included in said portion for specifying initial conditions.

24. (Previously Presented) The method of Claim 21, further comprising:

selecting a solver type specifying a particular technique used in solving said combined set of partial differential equations.

25. (Original) The method of Claim 24, wherein said solver type uses a finite element method.

26. (Previously Presented) The method of Claim 1, further comprising:

using a graphical user interface in connection with input data;

storing said input data in a representation in a data structure stored in a memory of said first physical computing device or said second physical computing device; and

converting said input data into an intermediate form wherein said intermediate form for each set of partial differential equations associated with said one of said plurality of physical systems is used in forming said combined set.

27. (Previously Presented) The method of Claim 1, further comprising:

determining a submode setting associated with one of the sets of partial differential equations associated with said one of said plurality of systems; and

determining a number of variables included in said one set of partial differential equations in accordance with said submode setting and a type of a corresponding application mode.

28. (Original) The method of Claim 27, wherein said submode is one of stationary, time dependent, linear, non-linear, scalar and multi-component.

29. (Original) The method of Claim 1, further comprising:

selecting at least one application mode.

30. (Original) The method of Claim 29, wherein said at least one application mode is one of predefined and user defined.

31. (Original) The method of Claim 30, further comprising:

modifying a set of routines associated with a predefined application mode to be used in connection with a user defined application mode.

32. (Previously Presented) The method of Claim 1, wherein said one of said plurality of physical systems being modeled is a one-dimensional geometry model.

33. (Previously Presented) The method of Claim 1, wherein said one of said plurality of physical systems being modeled is a two-dimensional geometry model.

34. (Previously Presented) The method of Claim 1, wherein each of said plurality of physical systems being modeled has up to a three-dimensional geometry.

35. (Original) The method of Claim 31, further comprising:

defining a user-defined application mode.

36. (Original) The method of Claim 35, wherein said defining a user-defined application mode further comprises:

defining an object class corresponding to said user-defined application mode; and

defining a first portion of methods included in said object class using functionality that is inherited from other classes.

37. (Original) The method of Claim 36, further comprising:

overloading a second portion of methods to provide alternative functionality.

38. (Original) The method of Claim 37, further comprising:

using overloading in connection with at least one method to disable functionality of said at least one method.

39. (Original) The method of Claim 31, further comprising:

defining an application that is a subclass of an existing class corresponding to functionality of an application mode.

40. (Original) The method of Claim 39, wherein said application mode is user-defined.

41. (Original) The method of Claim 39, wherein said application mode is predefined.

42. (Previously Presented) An apparatus for producing a model of a combined physical system having physical quantities by representing physical quantities of said combined physical system in terms of a combined set of partial differential equations, said apparatus comprising:

a computer comprising a processor, a user input device, a display device, and a memory device, said memory device containing executable instructions for producing said model of said combined physical system having physical quantities by representing physical quantities of said combined physical system in terms of said combined set of partial differential equations, said executable instructions causing said processor to perform, upon execution, acts comprising

representing in up to three space dimensions at least one of a plurality of systems as two or more selected application modes modeling physical quantities of said one of said plurality of systems;

using said processor, determining a set of partial differential equations for each of said two or more selected application modes, parameters of said partial differential equations being physical quantities of corresponding ones of said plurality of systems;

forming said combined set of partial differential equations using sets of partial differential equations associated with said one of said plurality of systems; and

outputting said model of said combined physical system to said display device or a communication device, said model based on said combined set of partial differential equations for said two or more selected application modes for ~~the~~ said one of said plurality of systems, whereby said model represents a mathematical expression of said physical quantities of said combined physical system.

43. (Previously Presented) The apparatus of Claim 42, further comprising:

representing at least one of said physical quantities of a first of said plurality of application modes using at least one dependent variable in said set of partial differential equations corresponding to said first of said application modes.

44. (Previously Presented) The apparatus of Claim 43, further comprising:

representing said at least one of said physical quantities directly as said at least one dependent variable.

45. (Previously Presented) The apparatus of Claim 44, further comprising:

representing said at least one of said physical quantities using a relation between said at least one dependent variable and another variable representing said at least one physical quantity.

46. (Previously Presented) The apparatus of Claim 45, wherein said at least one of said physical quantities is represented using at least one of: a numerical value and a mathematical expression.

47. (Previously Presented) The apparatus of Claim 46, further comprising:

forming said mathematical expression including at least one of: a time coordinate, a numerical value, and an actual physical quantity.

48. (Previously Presented) The apparatus of Claim 42, further comprising:

associating at least one subdomain with each application mode.

49. (Previously Presented) The apparatus of Claim 48, wherein each of said physical quantity is described by at least one physical property, and the apparatus further comprises:

disabling at least one physical quantity and associated variables for a portion of a subdomain.

50. (Previously Presented) The apparatus of Claim 42, further comprising:

displaying a partial differential equation in one of a: coefficient view and a general form corresponding to a representation of said partial differential equation; and

modifying a portion of said partial differential equation.

51. (Previously Presented) The apparatus of Claim 50, further comprising:

modifying at least one boundary condition of said partial differential equation.

52. (Previously Presented) The apparatus of Claim 50, further comprising:

modifying at least one coefficient of said partial differential equation.

53. (Previously Presented) The apparatus of Claim 50, further comprising:

obtaining data using a graphical user interface in connection with said one of said plurality of systems.

54. (Previously Presented) The apparatus of Claim 50, wherein said user input device and said display device comprise a graphical user interface.

55. (Previously Presented) The apparatus of Claim 42, further comprising:

solving said combined set of partial differential equations using a coefficient form of said combined set of partial differential equations.

56. (Previously Presented) The apparatus of Claim 42, further comprising:

solving said combined set of partial differential equations using a general form of said combined set of partial differential equations.

57. (Previously Presented) The apparatus of Claim 56, further comprising:

converting at least one set of partial differential equations included in said combined set of partial differential equations from coefficient to general form.

58. (Previously Presented) The apparatus of Claim 57, further comprising:

converting said combined set of partial differential equations from coefficient to general form.

59. (Previously Presented) The apparatus of Claim 58, further comprising:

using linearization of a general form to solve for a non-linear system of partial differential equations.

60. (Previously Presented) The apparatus of Claim 59, further comprising:

using a Newton method in solving for said non-linear system of partial differential equations.

61. (Previously Presented) The apparatus of Claim 42, further comprising:

solving said combined set of partial differential equations.

62. (Previously Presented) The apparatus of Claim 61, wherein said solving said combined set further includes:

selecting a portion of physical quantities in said combined set of partial differential equations; and

solving for one or more variables associated with said portion of variables.

63. (Previously Presented) The apparatus of Claim 62, further comprising:

using values associated with physical quantities not included in said portion for specifying initial conditions.

64. (Previously Presented) The apparatus of Claim 61, further comprising:

selecting a solver type specifying a particular technique used in solving said combined set of partial differential equations.

65. (Previously Presented) The apparatus of Claim 64, wherein said solver type includes solving a system of partial differential equations using a finite element method.

66. (Previously Presented) The apparatus of Claim 42, further comprising:

receiving input data for said model using a graphical user interface;

storing said input data in a representation in a data structure stored in said memory device of said computer; and

converting said input data into an intermediate form wherein said intermediate form for each set of partial differential equations associated with said one of said plurality of systems is used in forming said combined set.

67. (Previously Presented) The apparatus of Claim 42, further comprising:

determining a submode setting associated with one of the sets of partial differential equations associated with said one of said plurality of systems; and

determining a number of variables included in said one set of partial differential equations in accordance with said submode setting and a type of a corresponding application mode.

68. (Previously Presented) The apparatus of Claim 67, wherein said submode is one of stationary, time dependent, linear, non-linear, scalar and multi-component.

69. (Previously Presented) The apparatus of Claim 42, further comprising:

selecting at least one application mode.

70. (Previously Presented) The apparatus of Claim 69, wherein said at least one application mode is one of predefined and user defined.

71. (Previously Presented) The apparatus of Claim 70, further comprising:

defining a user defined application mode; and

modifying a set of routines associated with a predefined application mode to be used in connection with a user defined application mode.

72-74. (Cancelled).

75. (Previously Presented) The apparatus of Claim 42, further comprising:
defining a user-defined application mode.

76. (Previously Presented) The apparatus of Claim 75, further comprising:
defining an object class corresponding to said user-defined application mode; and
defining a first portion of methods included in said object class using functionality that is inherited from other classes.

77. (Previously Presented) The apparatus of Claim 76, further comprising:
overloading a second portion of methods to provide alternative functionality.

78. (Previously Presented) The apparatus of Claim 77, further comprising:
using overloading in connection with at least one method to disable functionality of said at least one method.

79. (Previously Presented) The apparatus of Claim 42, further comprising:
defining an application that is a subclass of an existing class corresponding to functionality of an application mode.

80. (Previously Presented) The apparatus of Claim 79, wherein said application mode is user-defined.

81. (Previously Presented) The apparatus of Claim 79, wherein said application mode is predefined.

82. (Previously Presented) A method executed in a computer system with at least one processor for producing a model of a combined physical system having physical quantities by representing physical quantities of the combined physical system in terms of a combined set of partial differential equations, the method comprising:

defining a plurality of user-defined application modes modeling physical quantities of an associated model having up to three space dimensions, wherein the application modes are configured to model the physical quantities of at least one of a structural system, a fluids system, and an electromagnetic system;

selecting two or more of the user-defined application modes;

using the processor, determining sets of partial differential equations for the selected two or more user-defined application modes of the associated model, parameters of the partial differential equations being physical quantities of the associated model; and

outputting, to a memory device or a communication device, the model based on a combination of the determined sets of partial differential equations for the two or more selected user-defined application modes for the associated model, whereby the model represents physical quantities of the combined physical system.

83. (Previously Presented) The method of Claim 82, further comprising:

solving for said set of partial differential equation using a finite element method.

84. (Cancelled).

85. (Previously Presented) The method of Claim 82, wherein said defining a user-defined application mode further comprises:

defining an object class corresponding to said user-defined application mode; and

defining a first portion of methods included in said object class using functionality that is inherited from other classes.

86. (Original) The method of Claim 85, further comprising:

overloading a second portion of methods to provide alternative functionality.

87. (Original) The method of Claim 86, further comprising:

using overloading in connection with at least one method to disable functionality of said at least one method.

88. (Cancelled).

89. (Original) The method of Claim 82, further comprising:

defining at least one user-defined application that is a subclass of an existing class associated with an application mode.

90. (Original) The method of Claim 89, wherein said application mode associated with said existing class is user-defined.

91. (Original) The method of Claim 89, wherein said application mode associated with said existing class is predefined.

92. (Previously Presented) An apparatus for producing a model of a combined physical system having physical quantities by representing physical quantities of said combined physical system in terms of solving a system of partial differential equations, said apparatus comprising:

a computer system comprising a processor, a user input device, a display device, and a memory device, said memory device containing executable instructions for producing said model of said combined physical system having physical quantities by representing physical quantities of said combined physical system in terms of solving a system of partial differential equations, said executable instructions causing said processor to perform, upon execution, acts comprising

defining a plurality of user-defined application modes modeling physical quantities of an associated model;

selecting two or more of said user-defined application modes;

using said processor or another processor, determining sets of partial differential equations for said selected two or more user-defined application modes of said associated model, parameters of said partial differential equations being physical quantities of corresponding systems; and

outputting to at least one of said display device, another memory device, and a communication device said model based on a combination of said determined sets of partial differential equations for said two or more selected user-defined application modes for said associated model, whereby said model represents a mathematical expression of said physical quantities of said combined physical system.

93. (Previously Presented) The apparatus of Claim 92, further comprising:

solving for said set of partial differential equations using a finite element method.

94. (Cancelled).

95. (Previously Presented) The apparatus of Claim 92, wherein said defining a user-defined application mode further comprises:

defining an object class corresponding to said user-defined application mode; and

defining a first portion of methods included in said object class using functionality that is inherited from other classes.

96. (Previously Presented) The apparatus of Claim 95, further comprising:

overloading a second portion of methods to provide alternative functionality.

97. (Previously Presented) The apparatus of Claim 96, further comprising:

using overloading in connection with at least one method to disable functionality of said at least one method.

98. (Previously Presented) The apparatus of Claim 97, further comprising:

selecting a plurality of application modes associated with at least one of a plurality of systems, said user-defined application being one of said plurality of application modes selected; and

forming a combined set of partial differential equations using sets of partial differential equations associated with said plurality of application modes.

99. (Previously Presented) The apparatus of Claim 92, further comprising:

defining at least one user-defined application that is a subclass of an existing class associated with an application mode.

100. (Previously Presented) The apparatus of Claim 99, wherein said application mode associated with said existing class is user-defined.

101. (Previously Presented) The apparatus of Claim 99, wherein said application mode associated with said existing class is predefined.

102. (Previously Presented) The method of Claim 34, wherein said representation of at least one of said plurality of physical systems as two or more selected application modes modeling physical quantities includes a time dimension.

103. (Previously Presented) The method of Claim 1, further comprising:

storing said output of said model of said combined physical system in a computer readable memory or in a computer readable storage system located within said first physical computing device or said second physical computing device.

104. (Previously Presented) The method of Claim 34, further comprising:

storing said output of said model of said combined physical system in a computer readable memory or in a computer readable storage system located within said first physical computing device or said second physical computing device.

105. (Previously Presented) The method of Claim 102, further comprising:

storing said output of said model of said combined physical system in a computer readable memory or in a computer readable storage system located within said first physical computing device or said second physical computing device.

106. (Previously Presented) The method of Claim 1, further comprising:

storing said output of said model of said combined physical system in a data storage system, said data storage system communicatively connected to said communication device and to a plurality of host computers comprising at least one of said first physical computing device and said second physical computing device.

107. (Previously Presented) The method of Claim 102, further comprising:

storing said output of said model of said combined physical system in a data storage system, said data storage system communicatively connected to said communication device and to a plurality of host computers comprising at least one of said first physical computing device and said second physical computing device.

108. (Previously Presented) The method of Claim 1, further comprising:

displaying said output of said model of said combined physical system on said display device, wherein said first physical computing device or said second physical computing device comprise said display device.

109. (Previously Presented) The method of Claim 103, further comprising:

displaying said output of said model of said combined physical system on said display device, wherein said first physical computing device or said second physical computing device comprise said display device.

110. (Previously Presented) The method of Claim 107, further comprising:

displaying said output of said model of said combined physical system on said display device, wherein said first physical computing device or said second physical computing device comprise said display device.

111. (Previously Presented) The apparatus of Claim 42, wherein said plurality of systems comprise at least one of a structural system, a fluids system, and an electromagnetic system.

112. (Previously Presented) The apparatus of Claim 42, wherein said representation of at least one of a plurality of systems as two or more selected application modes further includes a time dimension.

113. (Previously Presented) The method of Claim 82, wherein said associated model further includes a time dimension.

114. (Previously Presented) The apparatus of Claim 92, wherein said associated model has up to three space dimensions.

115. (Previously Presented) The apparatus of Claim 92, wherein said physical systems comprise at least one of a structural system, a fluids system, and an electromagnetic system.

116. (Previously Presented) A method executed in a computer system with at least one physical computing device for producing a model of a combined physical system having physical quantities by representing physical quantities of said combined physical system in terms of a combined set of partial differential equations, said method comprising:

representing in up to three space dimensions at least one of a plurality of systems as two or more selected application modes modeling physical quantities of said at least one of said plurality of systems, wherein said systems include a structural system, a fluids system, an electromagnetic system, or any combination thereof;

using a first physical computing device to determine a set of partial differential equations for each of said two or more selected application modes, parameters of said partial differential equations being physical quantities of corresponding ones of said plurality of systems;

using said first physical computing device or a second physical computing device to form said combined set of partial differential equations using the determined sets of partial differential equations associated with said one of said plurality of systems; and

outputting to a display device, a storage device, or a communication device said model of said combined physical system based on said combined set of partial differential equations for the two or more selected application modes for said one of said plurality of systems, whereby said model represents a mathematical expression of said physical quantities of said combined physical system.

117. (Previously Presented) A method executed in a computer system with at least one physical computing device for producing a model of a combined physical system having physical quantities by representing physical quantities of said combined physical system in terms of a combined set of partial differential equations, said method comprising:

representing at least one of a plurality of systems as two or more selected application modes modeling physical quantities of said at least one of said plurality of systems, wherein said systems comprise at least one of a structural system, a fluids system, and an electromagnetic system;

using a first physical computing device to determine a set of partial differential equations for each of said two or more selected application modes, parameters of said partial differential equations being physical quantities of corresponding ones of said plurality of systems;

using said first physical computing device or a second physical computing device to form said combined set of partial differential equations using the determined sets of partial differential equations associated with said one of said plurality of systems; and

outputting to a display device, a storage device, or a communication device said model of said combined physical system based on said combined set of partial

differential equations for the two or more selected application modes for said one of said plurality of systems, whereby said model represents a mathematical expression of said physical quantities of said combined physical system.

118. (Previously Presented) A method executed in a computer system with at least one physical computing device for producing a model of a combined physical system having physical quantities and a solution to said model, said method comprising:

representing said combined physical system by a geometry described by a mesh and a set of physical properties, said mesh including a plurality of elements, each of said elements being characterized by a shape;

providing a plurality of application modes;

selecting at least a first and a second of said application modes;

using a first physical computing device to generate a first plurality of partial differential equations based on said first application mode and a second plurality of partial differential equations based on said second application mode, each of the partial differential equations representing a behavior of at least one of said physical quantities of said model in response to said set of physical properties;

using said first physical computing device or a second physical computing device and the first and second pluralities of partial differential equations to form a combined system of partial differential equations;

generating a solution using said combined system of partial differential equations, said solution comprising numerical values for said physical quantities of node points in said mesh;

and

storing in a computer readable memory or in a computer readable data storage system said solution to said model.

119. (Previously Presented) A method of Claim 118, further comprising:

producing a physical component corresponding to said mesh and said set of physical properties.

120. (Previously Presented) A method of Claim 118, further comprising:

displaying said output of said model of said combined structural system on said display device, wherein said first physical computing device or said second physical computing device comprise said display device,

wherein said computer readable memory or said computer readable storage system is located within said first physical computing device or said second physical computing device.

121. (Previously Presented) An apparatus for producing a model of a combined fluids system having physical quantities by representing said physical quantities of said combined fluids system by partial differential equations, said apparatus comprising:

a computer system comprising at least one processor, a user input device, a display device, and a memory device, said memory device containing executable instructions for producing a model of the combined fluids system by representing the physical quantities of the combined fluids system in terms of partial differential equations, the executable instructions causing the processor to perform, upon execution, acts comprising

representing the combined fluids system by a geometry described by a mesh and a set of physical properties, the mesh including a plurality of elements, each of the elements being characterized by a shape;

providing a plurality of application modes;

selecting at least a first and a second of the application modes;

generating a first plurality of partial differential equations based on the first application mode and a second plurality of partial differential equations based on the second application mode, each of the partial differential equations

representing a behavior of at least one of the physical quantities of the model in response to the set of physical properties;

forming a combined system of partial differential equations based on the first and second pluralities of partial differential equations;

generating a solution based on the combined system of partial differential equations, the solution comprising numerical values for the physical quantities of node points in the mesh;

and

storing in a computer readable memory or in a computer readable data storage system the solution to the model.

122. (Previously Presented) An apparatus for producing a model of a combined system having physical quantities by representing said physical quantities of said combined system by partial differential equations, said apparatus comprising:

a physical computing system comprising ~~at~~ a first processor and a second processor, a user input device, a display device, and a memory device, said memory device containing executable instructions for producing a model of the combined system by representing the physical quantities of the combined system in terms of partial differential equations, the executable instructions causing the first processor or another processor to perform, upon execution, acts comprising

representing the combined system by a geometry described by a mesh and a set of physical properties, the mesh including a plurality of elements, each of the elements being characterized by a shape;

providing a plurality of application modes;

selecting at least a first and a second of the application modes;

using the first processor or the second processor to generate a first plurality of partial differential equations based on the first application mode and a second plurality of partial differential equations based on the second application

mode, each of the partial differential equations representing a behavior of at least one of the physical quantities of the model in response to the set of physical properties;

forming a combined system of partial differential equations based on the first and second pluralities of partial differential equations;

generating a solution based on the combined system of partial differential equations, the solution comprising numerical values for the physical quantities of node points in the mesh;

and

storing in a computer readable memory or in a computer readable data storage system the solution to the model.